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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a body activity controlled heart pacer provided for being positioned at or in the body of a patient.

Description of the Prior Art

The European Patent Application 0 089 014 (Plicchi et al.) describes a body activity controlled heart pacer, which utilizes a respiration signal, that is derived from a body impedance measurement, as a body activity signal. The electrodes for measuring the body impedance are positioned in a body location which is different from the heart pacer capsule location. Furthermore, the electrodes are connected by leads (wire) to stimulation pulse rate controlling means inside the pacer capsule. A lead connection is, however, technically too complicated, especially if a plurality of sensors is employed.

A similar rate adaptive pacer is depicted in U.S. Patent 4,428,378 (Anderson et al.). This pacer utilizes a motion sensor instead of an impedance (respiration) sensor to measure body activity. The motion sensor is inserted in the pacer capsule and again connected by wire to the remaining pacer components inside the pacer capsule. External body activity connection leads are not required in this case; the pacer capsule nevertheless becomes more voluminous.

Another body activity controlled pacer is being marketed by Siemens-Elema under the name SENSOLAG 703 (See, for example, Siemens brochure A91003-M3372-L943-01-7600). A piezoelectric sensor is also used in this case. The signals are, however, processed differently from Anderson et al.

US-A-4 543 955 discloses a body implantable sensor for controlling a body implantable action device, e.g. a pacer, in response to changes in a physiological parameter sensed by the sensor. The sensor and the action device may be placed at different locations in the body, and the sensor comprises a radio frequency transmitter for transmitting signals based on said changes to the action device. The action device alters its operation in response to these signals, such as, in the case of a pacer, the rate of the pacing pulses.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a pacer capsule for a body activity controlled pacer, which requires as little volume as possible, even when a plurality of sensors are used. It is another object of the invention to provide a body activity controlled pacer, which utilizes no external leads for connecting one or more sensors with a pacer capsule. It is still a further object of the present invention to provide a body activity controlled pacer, which may be located in or at a body of a patient, such that body activity may be optimally registered.

According to the present invention a body activity controlled heart pacer is provided for being positioned at or in the body of a patient, which comprises:

a) a first device including:

a1) pulse generating means for generating stimulation pulses at a basic rate;

a2) controlling means for controlling said pulse generating means such that said basic rate is varied as a function of at least one body activity signal; and

b) a second device including means for sensing body activity and for generating said body activity signal;

wherein said first device is provided for being positioned in or at a first body location; and wherein said second device is provided for being positioned in or at a second body location; and wherein said means for sensing body activity comprises means for wirelessly transmitting said body activity signal; and wherein said controlling means comprises means for wirelessly receiving said body activity signal, **characterized in** that said first device additionally comprises means for obtaining and transmitting an information signal and said second device additionally comprises means for receiving and functioning in response to said information signal.

According to the invention, the body activity sensors are disposed in a device, which is separate from the pacer capsule. The pacer can again be dimensioned as small as possible. Contrary to the past, however, a wire connection is no longer necessary. Under the circumstances, the sensors can be positioned in such body locations which are optimally suited for measuring body activity, while the smaller pacer capsule sits in its usual location. In case a plurality of body activity sensors is employed for measuring a variety of body activity parameters (e.g. such as temperature, respiration, motion, blood oxygen), each sensor can be positioned in a separate device and in a location which is most suitable for measuring the corresponding parameter.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the positioning of a pacer capsule including the pacing lead and two body activity sensors at different locations within the body of a patient.

Figure 2 is a schematic block diagram of a body activity controlled heart pacer in accordance with Figure 1, utilizing the principles of the present invention.

Figure 3 is a detailed schematic block diagram of a sensor unit of Figure 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Figure 1 a pacer capsule 1 is implanted in the body 2 of a patient. An ordinary pacing lead 3, connected to the pacer capsule 1, is inserted with its pacing electrode 4 in the heart 5 of the patient. A first sensor unit 6 is positioned at a first location (e.g. under the ribs). A second sensor unit 7 is implanted beneath the skin of one of the patient's thighs. The first sensor unit 6 measures, for example, body temperature, while the second unit 7 measures body motion.

In Figure 2, the pacer capsule 1 comprises a basic rate stimulation pulse generator 8, a stimulation rate controlling unit 9, a multiplexer 10, and a receiving unit 11. The receiving unit 11 is connected with a signal input 12, that is electrically insulated from the surface 13 of the pacer capsule 1. The signal input 12 serves as a receiving antenna 14 (as indicated by broken lines).

The first sensor unit 6 comprises a body activity sensor 15, which measures, for example, body temperature and thereupon supplies a body activity signal. The first sensor unit 6 also comprises a body activity signal processing and transmitting unit 16. A signal output for the transmitted signal is generally designated with reference number 17. This signal output 17 serves as a transmitting antenna 18, as indicated by broken lines. The transmitting signal wirelessly transmitted from the signal output 17 of the first sensor unit 6 to the signal input 12 of the pacer capsule 1 is referenced by 19. Correspondingly, the second sensor unit 7 comprises a body activity sensor 20, which measures, for example, body motion and thereupon supplies a second body activity signal. The second sensor unit 7 also comprises a body activity signal processing and transmitting unit 21. A signal output 22 serves as a transmitting antenna 23, as again indicated by broken lines. The wirelessly transmitted signal from the signal output 22 of the second sensor unit 7 to the signal input 12 of the pacer capsule 1 is referenced by 24.

The operation is as follows: the signals 19 and 24 transmitted from the first and second sensor units 6, 7 pass through body tissue and are received by the receiving unit 11 inside the pacer capsule 1 via signal input 12. Multiplexer 10 multiplexes the amplified output signal of the receiving unit 11 and supplies its output signal to the stimulation rate controlling unit 9. The stimulation rate controlling unit 9 controlls the basic rate stimulation pulse generator 8 by varying the basic rate as a function of the output signals of the first and/or second sensor units 6, 7.

The signal transfer can be one-way from the first and second sensor units 6, 7 to the pacer capsule 1. Preferably however, this transfer is two-way, as indicated by wavy arrows 25, 26. In this case, information (e.g. control data) can be transmitted from the pacer capsule 1 through antenna 14 to antennas 18 and 23 of the first and second sensor units 6, 7, respectively. The antenna 14 then works as a transmitting antenna and the antennas 18 and 23 of the first and second sensor units 6, 7 function as receiving antennas. For this purpose, the pacer capsule 1 also includes a transmitting unit 27. The body activity signal processing and transmitting units 16, 21 of the first and second sensor units 6, 7 are respectively supplemented by receiver units 28, 29.

The additional information transmitted from the pacer capsule 1 to the first and second sensor units 6, 7 can be control signals, used for switching the first and second sensor units 6, 7 on and off, or for altering other parameters of these units. For this purpose, the transmitting unit 27 inside the pacer capsule 1 can be controlled by an external programmer and recorder unit 30. The external programmer and recorder unit 30 may also program and record further parameters of the components housed in pacer capsule 1 (e.g. basic rate stimulation pulse generator 8 and/or multiplexer 10).

Figure 3 shows a sensor unit, for example body temperature sensor unit 6, in a detailed schematic block diagram. As can be seen from this Figure, the body activity signal processing and transmitting unit 16 comprises a power source 31 (e.g. battery), a buffer circuitry 32, a signal converter 33, an analog to digital converter 34, a microprocessor 35, including a data memory 36 and a program memory 37, and transfer electronics 38.

Claims

1. A body activity controlled heart pacer, provided for being positioned in or at the body of a patient, comprising:
   a) a first device (1) including:

a1) pulse generating means (8) for generating stimulation pulses at a basic rate;
a2) controlling means (9) for controlling said pulse generating means such that said basic rate is varied as a function of at least one body activity signal;
b) a second device (6, 7) including means (15, 20) for sensing body activity and for generating said body activity signal;
wherein said first device (1) is provided for being positioned in or at a first body location; and wherein said second device (6, 7) is provided for being positioned in or at a second body location; and wherein said means (15, 20) for sensing body activity comprises means (16, 21) for wirelessly transmitting said body activity signal; and wherin said controlling means (9) comprises means (11) for wirelessly receiving said body activity signal, **characterized in** that said first device (1) additionally comprises means (27) for obtaining and transmitting an information signal and said second device additionally comprises means (28, 29) for receiving and functioning in response to said information signal.

2. A pacer according to claim 1, whereby said information signal is generated by a programmer/recorder unit (30) located outside the body of said patient.

Patentansprüche

1. Ein durch körperliche Aktivität gesteuerter Herzschrittmacher, der für die Positionierung im oder am Körper eines Patienten vorgesehen ist, mit:
a) einer ersten Anordnung (1) mit:
a1) einem Impulsgenerator (8) zum Erzeugen von stimulierungsimpulsen mit einer Grundfrequenz;
a2) Steuermitteln (9) zum Steuern des Impulsgenerators derart, daß die Grundfrequenz als Funktion wenigstens eines von der körperlichen Aktivität abgeleiteten Signals variiert wird;
b) einer zweiten Anordnung (6,7) mit Abfühlmitteln (15,20) zum Abfühlen der körperlichen Aktivität und zum Erzeugen des von dieser abgeleiteten Signals;
wobei die erste Anordnung (1) für eine erste Positionierung im oder am Körper und die zweite Anordnung für eine zweite Positionierung im oder am Körper vorgesehen ist, wobei die Abfühlmittel (15,20) zum Abfühlen der körperlichen Aktivität einen Sender (16,21) zum drahtlosen Übertragen des von der körperlichen Aktivität abgeleiteten Signals aufweisen und wobei die Steuermittel (9) einen Empfänger (11) zum drahtlosen Empfangen des von der körperlichen Aktivität abgeleiteten Signals aufweisen, **dadurch gekennzeichnet**, daß die erste Anordnung (1) zusätzlich Mittel (27) zum Erhalten und Übertragen eines Informationssignals und die zweite Anordnung zusätzlich Mittel (28,29) zum Empfangen des und zum Wirken auf das Informationssignal aufweisen.

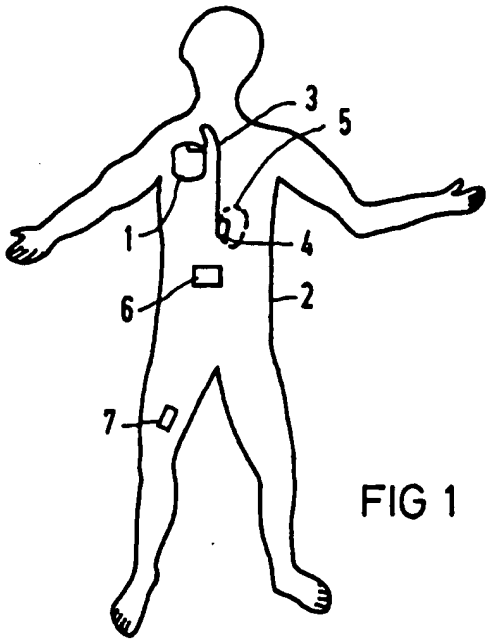
2. Ein Herzschrittmacher nach Anspruch 1, wobei das Informationssignal durch eine Programmier/Recorder Einheit (30), die sich außerhalb des Körpers eines Patienten befindet, erzeugt wird.

Revendications

1. Stimulateur cardiaque commandé par l'activité corporelle, destiné à être mis en place dans ou sur le corps d'un patient, comprenant :
a) un premier dispositif (1) comprenant :
a1) des moyens (8) de production d'impulsions servant à produire des impulsions de stimulation à une cadence de base;
a2) des moyens de commande (9) servant à commander lesdits moyens de production d'impulsions de telle sorte que ladite cadence de base est modifiée en fonction d'au moins un signal de l'activité corporelle;
b) un second dispositif (6,7) comprenant des moyens (15,20) pour détecter une activité corporelle et produire ledit signal d'activité corporelle; et
dans lequel ledit premier dispositif (1) est destinée à être mis en place dans ou sur un premier emplacement du corps; et ledit second dispositif (6,7) est destiné à être mis en place dans ou sur un second emplacement du corps; et dans lequel lesdits moyens (15,20) servant à détecter une activité corporelle comprennent des moyens (16,21) pour émettre sans fil ledit signal d'activité corporelle; et dans lequel lesdits moyens de commande (9) comprennent des moyens (11) pour recevoir, sans fil, ledit signal d'activité corporelle, caractérisé en ce que ledit premier dispositif (1) comprend en outre des moyens (27) pour obtenir et transmettre un signal d'informations et ledit second dispositif comprend en outre des moyens de réception (28,29), apte à fonctionner en réponse audit signal d'information.

2. Stimulateur suivant la revendication 1, dans lequel ledit signal d'information est produit par une unité de programmation/d'enregistrement

(30) située à l'extérieur du corps dudit patient.


3
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1
4
6
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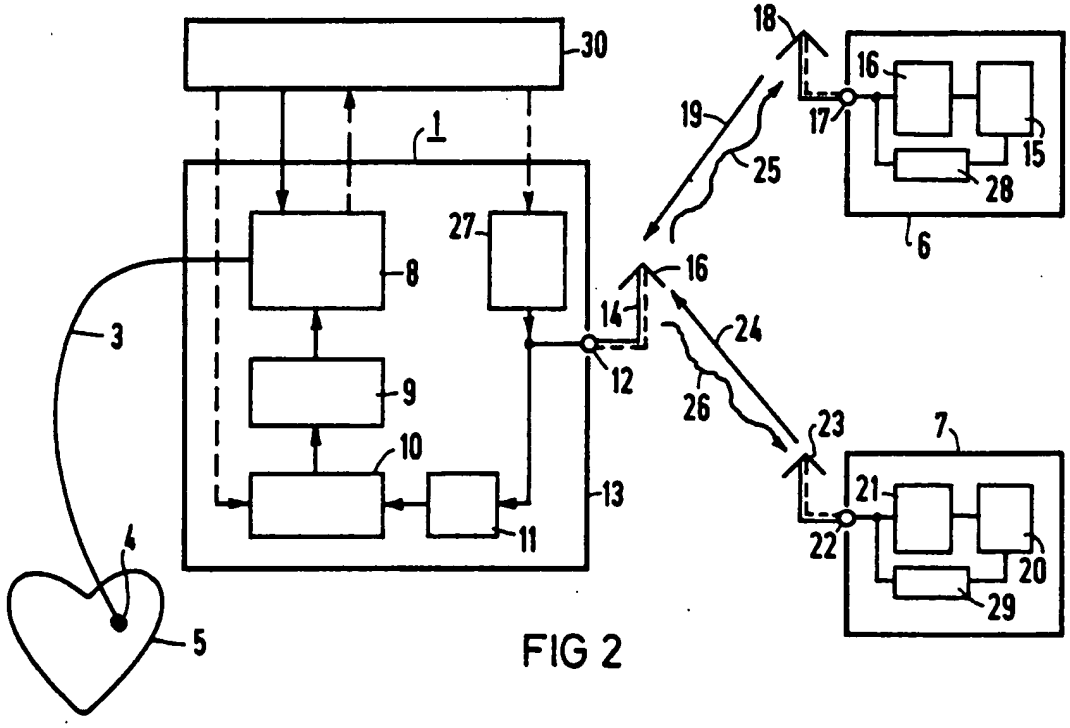
7

FIG 1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29
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FIG 2

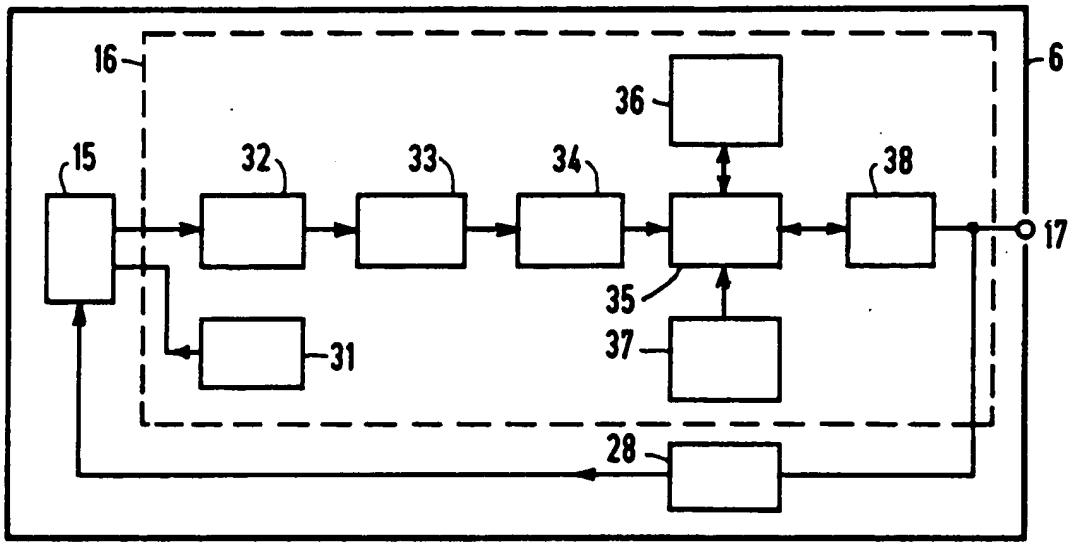

FIG 3